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NEW DESCRIPTOR FOR OBJECT DETECTION USING AN IMPROVED ENSEMBLE-BASED TECHNIQUE

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To my beloved parents, my wife, children, brothers and sisters

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ABSTRACT

Object detection is an essential process for further tasks including, but not limited to, object and event detection, object tracking, object recognition, video indexing, motion estimation, image restoration, image registration, image retrieval, and reconstruction of 3D scene. In the recent past, interest point detectors and their descriptors, as local features, have received a great interest in computer vision areas and technologies. These types of features have shown their robustness against different types of deformation due to geometric transformation, photometric transformation and other disturbances. Therefore, they are more accurate and stable than the global ones. Among all interest point detectors and descriptors, the Scale Invariant Feature Transform (SIFT) and Speeded-Up Robust Features (SURF) are considered as the most common methods that receive interest from researchers in terms of usage and development; but, getting more accurate, invariant and fast descriptor is still needed. Matching technique is often used to recognize the object based on such features; however, it is not proper for some applications such as searching for an isolated object and it is difficult to be used in object category recognition or to recognize the part-based object. Therefore, learning-based technique, that has been proven to be an effective method in object detection, can be used to overcome the previously mentioned challenges. However, the object required to be detected usually represents a small ratio compared to non-object that causes an imbalanced data problem. The aim of this study is to design and develop an effective model for object detection that is faster, more accurate and it can manage aforementioned challenges. To achieve this goal first, new fast and an accurate descriptor is introduced based on interest points; second, an effective classification method, that mitigates the effect of imbalanced data, is designed based on developed ensemble classifiers; third, an updating scheme of interest point detector is presented to speed up the object detection system. Results show that the proposed features are faster and more invariant than the most common interest-point-based features. The developed technique based on ensemble classifiers produces notable results in terms of accuracy and False Positive rate compared to the traditional one. The speed of object detection system has increased by 30% in average based on the proposed scheme.

ABSTRAK

Pengesanan objek adalah suatu proses yang penting dalam tugasan lanjut termasuk pengesanan objek dan acara, penjejakan objek, pengecaman objek, mengindek video, anggaran pergerakan, restorasi imej, pendaftaran imej, penemuan kembali imej and rekonstruksi adegan 3D. Sebelum ini, pengesan titik minat dan pemarihalnya, iaitu ciri-ciri sedia ada telah menarik minat yang mendalam di dalam bidang visi komputer dan teknologi. Ciri-ciri ini telah mempamerkan kecekalan terhadap beberapa jenis kecacatan yang disebabkan oleh transfomasi geometri, transfomasi fotometri dan gangguan yang lain. Oleh itu, ciri-ciri ini lebih tepat dan stabil daripada ciri-ciri global yang lain. Antara semua pengesan titik minat dan pemarihalnya, Ciri Transform Skala Invarian (SIFT) dan Ciri-Ciri Kelajuan Teguh (SURF) dianggap sebagai dua kaedah sepunya yang paling mendapat perhatian pengkaji dari aspek penggunaan dan pembangunan tetapi penemuan ciri-ciri kategori objek yang lebih cekal dan pantas masih diperlukan. Teknik pemadanan sering digunakan untuk mengenal pasti objek berdasarkan ciri-ciri tersebut. Namun, ia tidak sesuai untuk beberapa aplikasi seperti gelintar objek yang terpencil dan sukar untuk digunakan semasa pengecaman kategori objek atau pengecaman objek yang berdasarkan bahagian-bahagian. Justeru, teknik berdasarkan pembelajaran yang telah dibuktikan sebagai suatu kaedah yang berkesan untuk mengecam objek boleh digunakan untuk mengatasi cabaran-cabaran yang disebut sebelum ini. Walau bagaimanapun, objek yang perlu dikesan lazimnya melambangkan suatu nisbah yang kecil berbanding dengan benda-benda bukan berbentuk objek yang menimbulkan masalah ketidakseimbangan data. Tujuan kajian ini adalah untuk mereka bentuk dan membangunkan satu model yang berkesan untuk mengesan objek dengan lebih pantas, lebih tepat dan dapat mengurus cabaran-cabaran yang disebut tadi. Untuk mencapai matlamat ini, pertama, pengesan yang pantas dan tepat diperkenalkan berdasarkan titik-titik berkepentingan; kedua, satu kaedah klasifikasi yang berkesan dan mampu mengurangkan kesan ketidakseimbangan data yang direka bentuk berdasarkan pengklasifikasi ensembel yang dibangukan; ketiga, dikemukakan suatu skema yang dapat mengemaskini pengesan titik minat untuk mempercepatkan sistem pengecaman objek. Dapatan kajian menunjukkan bahawa ciri-ciri yang dicadangkan adalah lebih pantas dan lebih tepat berbanding ciri-ciri yang berdasarkan titik kepentingan yang sepunya. Teknik yang dibangunkan berdasarkan pengklasifikasi ensembel telah menghasilkan keputusan yang penting berkaitan kejituan dan kadar positif palsu berbanding dengan teknik tradisional. Namun, kelajuan sistem pengesanan objek telah meningkat 30% secara purata berdasarkan skema yang dicadangkan.